

Collaborative and Cooperative Games: Facts and Assumptions

Carolina Islas Sedano
School of Computing
University of Eastern Finland
Joensuu, Finland
carolina.islas@uef.fi

Maira B. Carvalho, Nicola Secco
DITEN
University of Genoa
Genoa, Italy
{maira.carvalho, nicola.secco}@elios.unige.it

C. Shaun Longstreet
Center for Teaching and Learning
Marquette University
Milwaukee, WI, USA
christopher.longstreet@marquette.edu

Abstract— Collaboration and cooperation are fundamental activities and processes for humans. There has been a recent rise in the interest in collaborative and cooperative processes in several fields of study and an increasing popularity of commercial collaborative games. In this paper, we aim to identify how are collaboration and cooperation processes studied and promoted in the field of game research, with emphasis in digital games. To that end, we systematically analyzed two sets of data: academic publications on collaborative games and reviews of commercial collaborative games. From this examination, we acknowledge the important relationship between games and the cultural context, and we identify three main areas of study for this type of games (learning environments, interaction, and in-gameplay experience), which serve as a landscape for the investigation on collaborative and cooperative games.

Keywords— Collaborative games, Collaborative serious games, Serious games aimed at supporting collaboration.

I. INTRODUCTION

Collaboration and cooperation are fundamental activities and processes for humans. Our societies are based on cooperation among individuals [1]. As a result, the topic is central to understand human behavior and social organization, and consequently it is studied by a myriad of areas, such as trade, community organization, game theory, project management, education, arts, business, entertainment, science and technology. This paper is an investigation on how are collaboration and cooperation processes studied and promoted in the field of game research, with emphasis in digital games.

Collaboration and cooperation are two distinct and complex concepts. From an instructional design perspective, Shih et al. [2] discuss that cooperative learning refers to the distribution of the work between learners, while collaborative learning means that peers create and study together throughout the whole learning process, without work distributions between them. Although there is a distinction, the terms are often used as

synonyms. For the purpose of the current study, we use the terms interchangeably, as we are interested in these processes from a more general angle. Therefore, we define both cooperation and collaboration as the activity in which individuals come together to produce a single outcome.

Despite the fact that collaboration has been an important research topic across several disciplines for a long time, only recently has it become prominent in the field of game research. Notwithstanding, collaboration has been present in games even before researchers started to become interested in the subject. Therefore, in order to have a clearer and more complete understanding of the topic, we should consider games from at least two different perspectives: from the standpoint of academia and from the standpoint of the industry.

We focus our investigation in digital games because of their importance and prominence in Western societies [3], but we nevertheless note that this is but one type of games, among many others to which individuals have access. Other categories of games, such as board games and physical games, also have their relevance and their influence on digital games [4].

This paper is organized as follows. In the next section we offer a brief background on board games to discuss the relationship between games and culture. In section 3, we present a definition of the term “game” and the game categorization that has been used in this study. In section 4 we delineate our research design and describe the two sets of data that were used in the investigation, the first one focused on academic publications and the second one focused on commercial games. Finally, section 5 presents the discussion and conclusions of our work.

II. BACKGROUND

Tom Werneck, a 73-year-old German game designer and critic, former member of the jury of the German award Spiel des Jahres (“Game of the Year”), in an interview conceded to

the German newspaper *Süddeutsche Zeitung*, observed that board games tend to express elements that are emblematic of the time in which they were created [5]. For example, he remarks that the board game Monopoly did not become relevant in Germany until the 50s, while in the United States the game gained considerable attention already in the 1930s, during the Great Depression [6]. On the other hand, in Germany after the World War II, the most popular board games focused on prosperity and travelling. The article lists the characteristics of the following decades and the games that were more prominent in those times, finally reaching the second decade of the new century, in which cooperative board games such as Pandemic [7] and CO₂ [8] are becoming more popular [5]. This phenomena is not exclusive to the German game arena, as similar patterns in other countries have been describe by historians as well [9–11].

The close relationship between games and the context in which the games appeared has been analyzed by different scholars. For example Johan Huizinga, in his book *Homo Ludens*, analyzed the interweaving of culture with games and play. In his words: “[i]t is through this playing that society expresses its interpretation of life and the world. By this we do not mean that play turns into culture, rather that in its earliest phases culture has the play-character, that it proceeds in the shape and mood of play. In the twin union of play and culture, play is primary” [10]. Huizinga also examined extensively competitive games. Later, French sociologist Roger Caillois [11] expanded the work of Huizinga by investigating different types of games, such as games of chance, roleplaying and vertigo. From another perspective, historians have analyzed games from particular cultures: Enrique Florescano, for example, paid attention to the Mexican games [9]. Recently, with the rise of digital games, academics are investigating the role of context in the design and development of digital games as it is shown in a diversity of works [12–18].

The increasing availability of collaborative games in the market offers a portrait of the times we are living in. The interest in collaborative and cooperative processes in several fields of study and the increasing popularity of collaborative games give a clear indication that this is indeed a relevant topic for investigation. By gaining and understanding on how collaboration and cooperation in games take place we can related this knowledge to other areas besides entertainment, such as in the growing body of research in Serious Games (SG) – that is, the association of pedagogy and instruction in the gameplay for purposes such as training, education and marketing [19] – which can highly benefit from a deeper investigation on how to utilize collaboration and cooperation and collaborative learning in general to produce better, more engaging and more effective serious games [20].

III. GAMES AND GAME CATEGORIES

For this paper, we adopted the following definition of a game: a system located in a play-space, consisting of game components (any unit essential to the functioning of the game system), game mechanics (game states and rules that define the allowed transitions between states) and game dynamics (all the possible actualizations of the game mechanics) [12]. As games

are located in a play-space, we can assume that players join these systems with a playful attitude [4].

There are diverse classification of games and game genres. Collaborative and cooperative games can, potentially, be utilized in a diversity of genres and narratives. However, the technology in digital games offers different types of interaction to support collaboration and cooperation. Therefore, in this work, we categorized digital games according to the scheme or technology that is primarily used: video games, location-based games, alternate reality games (ARG) and pervasive games [12]. These categories are described below.

Video games comprise consoles, handhelds and computer games. Their main characteristic is that it requires that players acquire a game cartridge that matches the console, or download the game application for the computer or mobile device. These games are not context-dependent, as anyone can play them anywhere, as long as the technical resources (e.g. hardware, internet, electricity, software) are available.

Location-based games rely on the technical capabilities of mobile technology like GPS, Bluetooth, WLAN, RFID and sensors. Most location-based games attempt to integrate players’ physical location into the game. In this category, the research on context awareness in mobile devices is relevant.

Alternate reality games (ARG) attempt to blur the boundaries between real life and the play-space. They present a strong and complex narrative that makes use of all possible media (digital and non-digital) available to and accessible by the players. Role-playing games, mystery novels and scavenger hunts have influenced alternate reality games [21]. A characteristic of this type of games is that players are always under observation and control of the game’s designers. Therefore this type of games is only playable for short periods of time, usually ranging from some days to a maximum of two or three months.

Pervasive games can be viewed as a subset of alternate reality games and location-based games. Both genres utilize real life elements, have a determined life span and contain strong narratives. However, the uniqueness of pervasive games lies in their temporal expansion, as described by Montola, Stenros, & Waern [22]. In other words, once players commit themselves to the game, it is the game that decides when they should play – even if the game starts infiltrating in the player’s real life.

The categories described above served as part of the analysis conveyed in this study. In the next section we describe the methodology for the data collection and analysis that was used in this work.

IV. RESEARCH DESIGN

As mentioned previously, in order to have an overview on how collaboration and cooperation process in digital games are currently studied, we considered two perspectives: the standpoint from the academia and from the gaming industry. Therefore, we systematically analyzed two sets of data exploring collaborative and cooperative games. The first set of data focused on academic publications, which offer a

theoretical understanding, while the second targeted commercial games, i.e. games available in the market.

A. Data Set I: academic publications

We carried out a comprehensive literature review of academic publications that analyzed collaboration in games. For several different reasons, academic publications often offer only short descriptions of the games used in their research, and consequently the data collected directly from the papers can be insufficient to yield a complete picture of those games. Nevertheless, we conducted this investigation to identify both the main topics and the methods of inquiry that scholars have been using when researching collaboration in games.

1) Data collection

The data collection consisted of the following steps:

1. *Selection of the source.* The ACM Guide to Computing Literature [23], one of the most comprehensive bibliographic databases focused on the field of computing, was selected as the digital repository for our study as it contains a diversity of quality articles across disciplines relevant for digital games.

2. *Definition of search keywords.* The keywords utilized were “collaborative games” and “cooperative games”. The search was restricted to the titles of the articles. The search for “game AND collaboration” retrieved 38 articles, while the search “game AND cooperation” resulted in 101 articles. Both search results were combined, giving a total of 139 articles that were included in the preliminary selection for the study.

3. *Definition of the instrument for analyzing the data.* The information extracted from the articles was summarized in a simple spreadsheet, which collected the basic information about the articles: (i) if the article is relevant or not relevant, (ii) why is the article relevant or not relevant, (iii) year of publication (iv) title of article. An article was considered relevant when it discussed collaboration or cooperation between individuals while playing or as consequence of playing a game. The cases that raised doubts with regard to their relevance to the study were discussed among the authors. For the relevant articles only, we filled also the following information in the spreadsheet: (v) Countries of authors’ affiliation, (vi) where was the article published (journal, conference, book, etc), (vii) Game name (as reported in the article), (viii) Game URL (ix) Game thematic (x) game platform (xi) main contribution of the article and (xii) Open questions (as reported by the authors of the article in question).

2) Data analysis and observations

a) Summary of the data

We read the abstracts of the main body of articles (139) to categorize what articles were relevant for further analysis. Only 28 of the articles were classified as relevant. It is interesting to note that the search for “games AND cooperation” yielded many results that focused on game theory as the mathematical model of decision making and on its application in fields such as network communications and artificial intelligence. Therefore, the articles that described game theory and its application as mechanism to improve algorithms, protocols or hardware were classified as not relevant.

From the selection of articles, it is possible to see clearly that the topic of collaborative games has started to draw more attention from the research community only very recently. The list of selected articles includes papers published since 2001. The topic was not very popular in the first half of the previous decade: there was less than one paper per year published on average from 2001 to 2005. In 2006 the research community started to give more attention to collaborative games, and the number of articles published about the subject raised to an average of almost 3 papers per year in the second half of the years 2000. The interest in the topic raised sharply in the last year: 7 papers were published in 2012. Figure 1 shows the distribution of articles per year of publication.

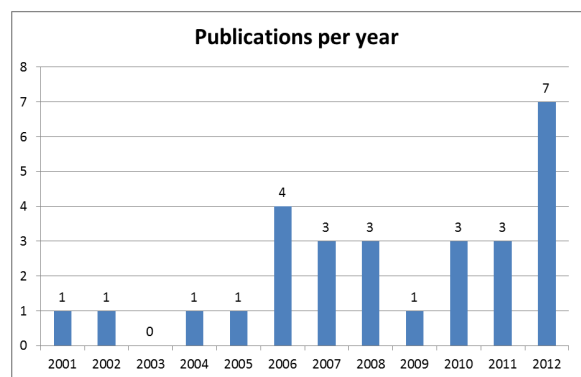


Figure 1. Number of articles on collaborative and cooperative games published per year.

Two thirds of the articles (19) were presented in conferences and workshops, while nine were published in journals. Among the papers published in journals, four articles appeared in a periodical dedicated to the use of computers in education and three articles appeared in a publication dedicated to examining the use of computers from a psychological perspective.

b) Interaction versus learning environment

Following the observation of the articles, two categories of studies emerged: those that focused on analyzing collaborative games from the point of view of their application in a learning environment, and those that focused on the analysis of the interaction itself in a collaborative games setting.

The first category – analysis of the learning environment – comprises 11 papers. Those were articles in which the authors attempted to analyze learning environments as a whole, as well as the elements related to them. They focused in how the game fits in the learning setting as a tool to improve learning through collaboration, discussing for example how collaborative games leveraged learning in specific settings, or how the games tried to stimulate collaboration between players in order to achieve specific learning goals. They also examined how specific collaboration models influenced the groups’ performances, the difficulties in promoting higher level collaboration (involvement of the group in tasks that required reasoning collaboratively, as opposed to collaboration in practical tasks) and the role of teachers in the process. Most of these papers focused on games for children and young teenagers [24–26];

there were also papers that dealt with the use of collaborative games for complementing learning in vocational schools [27–29]. A few articles described game proposals or games in a very early stage of development [30], [31].

The second group of papers, which focused on the analysis of the interaction itself (between individuals or with the system) in a collaborative game setting, comprised 17 papers in total. They reported experiences in which researchers attempted to investigate the mechanics of collaboration, sometimes focusing on collaboration specifically in games, and other times using experimental game setting to understand better how collaboration occurs, which factors (internal or external) can affect how people collaborate, how to design a system to support effective computer-mediated collaboration, which artifacts or modes of interaction are more effective, how specific tools impact the group’s effectiveness, which types of communication and collaboration take place during a game, etc. Unsurprisingly, the vast majority of the experiments and observations falling into this category were conducted with adult participants, mainly university students – as it is the demographic group that is the most easily available for researchers to recruit. Only one article focused on the analysis of the interaction in a game designed specifically for children [2], and another one investigated an intergenerational game targeting senior users [32].

It is relevant to mention that not all the articles explicitly mentioned the title of the game used in their research. Furthermore, as the games were varied and the descriptions of the games were not systematic or classified in a consistent manner, we were not able to extract reliable information regarding game mechanics. To be able to generate such an inventory, we would need to play the games and analyze them according to one single evaluation criteria. As this was not the objective of this work, we relied on the descriptions provided by the authors to identify game categories. Location-based games were the most commonly reported types of games in this data set; within that subset, research interventions in museums, especially using mobile devices, were common.

B. Data Set II: Commercial Games

We carried out a systematic examination of commercial game reviews. We are aware that the games descriptions offered in gaming websites are able to provide only a general insight on how the game promotes collaboration, and that the information in review websites does not follow academic standards. Nevertheless, it is the only information accessible at the moment that gives us an idea of which types of collaborative games are available in the market.

1) Data collection

The data collection consisted of the following steps:

1. *Selection of the source.* IGN [33] was selected as the repository of commercial games as it is one of the notable sites for reviews in digital games used by players and practitioners.

2. *Definition of search keywords.* The keywords used for searching the IGN repository were “collaborative” and “cooperative”. Each keyword was used separately in the

website search engine. When the keyword “collaborative” was used, the search delivered 63 results, while the keyword “cooperative” delivered 342 results. This study included only the 63 titles delivered by the keyword “collaborative”.

3. *Definition of the instrument for analyzing the data.* The information extracted from the games was summarized in an instrument designed for this purpose. From all the games, we gathered the following information: title, relevance, description, genre, publisher, launch date and any further notes.

2) Data analysis and observations

a) Relevance

The 63 selected games were classified according to their relevance for this study in the categories listed below, based on the descriptions available in the IGN website:

Relevant: the game description indicated that the gameplay is solely based on collaboration, as in the case of *Noby Noby Boy* [34] or *Little Big Planet* [35].

Half relevant: the game offers collaborative gameplay as one possible playing mode among others such as one-player mode or competition mode. Examples of this type of games: *Planet Crashers* [36] or *Rise of the Kasai* [37].

Not relevant: if the game does not offer a collaborative option of game play. Often these titles appeared in the search result because the description mentioned the collaboration between game designers or publishers in the game.

Out of the 63 selected games, 18 games were classified as relevant, 24 games were considered half relevant and 21 were not relevant. As it might have been anticipated, 62 titles in this data set fell in the category of *video games*, as described in section 3 of this paper. However one game (*Can You See Me Now?* [38]) was classified as an *alternate reality game*. Most game reviews stressed the technical capabilities that were utilized to support collaborative gameplay, highlighting that the game offers wireless networks possibilities or allows players to play over the internet.

The games classified as relevant represented a diversity of commercial game genres (e.g. fantasy, FPS, simulation). Consequently, one can find titles such as *Star Wars: Lethal Alliance* [39], which is an action game that encourages collaborative gameplay to make alliances to fight different legions, or games such *Planet Michael* [40], in which the gameplay aims to engage players to connect and collaborate through music.

From the data set, we observed that games that were considered strictly collaborative (that is, classified as relevant under the criteria explained above) started to be made available in the market in 2003. In addition, 2012 was the year with more launches of collaborative games. On the other hand, games classified as only half relevant have been in the market since 1999, according to IGN. Or, in other words, although it has been possible to find games that offer the possibility of playing in a collaborative mode in addition to the single-player since the end of the 90s, strictly collaborative games started to appear slightly later, no more than ten years ago.

V. DISCUSSION AND CONCLUSION

According to the evidence collected in this literature review, we confirm the general perception, expressed by game practitioners, that in recent years there has been an increasing interest in collaborative games in the industry and in the academia. This rise in the availability of collaborative games should not be considered unexpected: we are living in the era of the internet and social media, used by millions of individuals around the globe as a means for communication, sharing, and, of course, collaboration and cooperation. Thus, if games express elements that are emblematic of the time in which they were created, then it is natural to see the appearance and increasing importance of collaboration and cooperation elements in them. Often the games reported in this study utilized technology (e.g. wireless connectivity, internet access) to promote collaboration and cooperation.

The result of this review invites to further investigate Huizinga's analysis of how the entwinement of games and culture is evolving. Incidentally, at the end of his book "Homo Ludens", and despite the fact that he did not live in the digital era, Huizinga foresaw a transition of play and games from a representation that emerges from local cultures and their understanding of the world to profit-based business activities. The game industry often determines what types of technologies should be developed and allegedly aims to create global games that are consumed by masses world-wide, disregarding the very important local contexts in their games. Location-based games might act as a response to this trend, as this type of games can include contextual elements as game components. This might be one reason why location-based games are often reported in the analysis of game for learning instead of other platforms, while commercially are rarely used. Location-based games often bridge formal and informal learning supporting the creation of learning environments.

Bearing in mind that this paper is not an in-depth investigation of collaborative games, but an attempt to explore how collaboration is studied and promoted in the field of game research from the standpoints of the academia and the industry, we conclude our study with a summary of the research landscape in the field. Figure 2 illustrates the identified areas of investigation on *collaboration and cooperation in digital games* (represented by the large circle) across the two perspectives of this study (illustrated as the rectangles labeled "academic research" and "gaming industry"), and their relationship to three main areas of study: *learning environments*, *interaction*, and *in-gameplay experience*. Each area of study is explained below.

Learning environments refers to the involvement and blending of the game with a wider ecology of resources (material and human) to support learning. Therefore, when analyzing game mechanics in connection to the learning environment in collaborative and cooperative games, it is possible to obtain a better understanding on how games support or lessen learning experiences in different subjects, and considering the wider picture. Currently, the major emphasis in studying collaborative and cooperative games in this area seems to be on location-based applications.

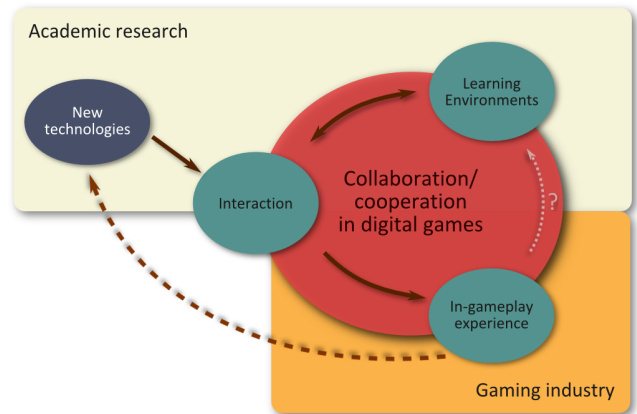


Figure 2. Synthesis of this exploration on collaborative games.

Interaction refers to the studies on game mechanics that support the communication between players with other peers and systems. Research in this area is strongly influenced by the development of the technology, as it is often the medium to support the communication between players.

In-gameplay experience is an area that allows the in-depth investigation of cooperative and collaborative game mechanics in the gameplay. The investigation of commercial games, which have more been promoting in-game collaborative and cooperative activities and processes for a longer time can give interesting insights to the academia.

Figure 2 also depicts the investigation of *new technologies*, even when not directly related to the research in digital games, and the arrows in the illustration depict the relationships between the areas according to the findings of this study. New technologies support the development of interaction research, which in turn provide the resources for the investigation of new possibilities for learning environments and new in-gameplay experiences. Indirectly, the industry also inspires the development of new technologies (consoles, interaction devices, communication protocols, wireless technologies, algorithms, etc.), which in its turn foster the growth of the gaming industry by delivering new possibilities of interaction, in a circular relationship.

It calls the attention of the authors that none of the reviewed papers studied collaborative or cooperative commercial games aiming to understand its game mechanics. The gaming industry has been releasing cooperative and collaborative games for a longer time than the academia. Consequently, the examination of high ranked collaborative games could offer a valuable understanding of what type of mechanics are utilized and how they are being applied in gameplay – effectively connecting the area of study in *learning environments* to the study of *in-gameplay experience*. These finding could be a valuable asset when developing games for learning.

Furthermore, we believe that the subject of how the game mechanics correlate with non-game systems and activities of collaboration and cooperation should be included in the research agenda. It is important that the research community investigates which types of cooperative and collaborative

interactions of non-game activities and systems are missing in the list of generally recognized game mechanics. In addition, as the topic of collaboration in games is still very recent, there is still no systematization of the terms used in the field. One of the avenues for future research could be the elaboration of a systematic taxonomy that allows identifying gameplay characteristics and game mechanics that characterize a game as collaborative or cooperative.

From the literature that has been reviewed, researchers claim achieving positive effects on learning with the use of games. However, there has been little work done in scrutinizing how those games function to support such advantages. Would it be possible to obtain the same results if learners were involved in non-game collaborative and cooperative activities? What are the benefits of using games if we do not evaluate what game mechanics induce or support collaboration and cooperation? Would the same claims on the effectiveness of the game prevail if those games did not use novel technologies? Is it possible to compare and map the game mechanics to actual collaborative and cooperative activities in non-game related scenarios? Which game mechanics more or less appropriate in which settings? At the moment there are more questions than answers to allow us to actually understand how games can support collaboration and cooperation.

Based on the evidence and discussion of this work, it is unquestionable that the research in collaborative and cooperative games is just starting.

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